CLAIMS

1. A pneumatic de-watering and drying apparatus (1) for wet product comprising a cyclone chamber (2) connected to a fan (3) having a housing (4) mounting blades (5), each blade (5) causing individual flow vortices to be formed downstream of the fan (3) which in turn combine to form cyclonic flow of the fluid within the cyclone chamber (2) in which the cyclone chamber (2) comprises at least one of a vortex flow forming section (6) feeding a vortex flow shedding section (7), the vortex flow forming section (6) comprising vortex flow forming means to cause reformation of vortex flow within the cyclone chamber (2) on dissipation of the vortex flow along the cyclone chamber (2) remote from the fan (3) and a product inlet hopper (12) downstream of the fan characterised in that ionisation means are provided to cause further ionisation of the fluid as it progresses through the cyclone chamber (2).

2. Apparatus (1) as claimed in claim 1, in which the ionisation means comprises a plasma generator (47) having an enclosed plasma chamber, at least part of which is mounted in close proximity to portions of the cyclone chamber (2) and in which the plasma chamber and those portions of the cyclone chamber (2) adjacent the plasma chamber are of a non-ferromagnetic material.

3. Apparatus (1) as claimed in claim 2, in which the plasma chamber is in the form of a hollow toroidal tube (48) surrounding a vortex flow forming section (6).

4. Apparatus (1) as claimed in claim 3, in which there is a plurality of torroidal tubes (48) surrounding the vortex flow forming section (6).

5. Apparatus (1) as claimed in claim 3 or 4, in which there are a plurality of vortex flow forming sections (6) and each vortex flow forming section (6) is surrounded by a plasma chamber.

6. Apparatus (1) as claimed in claim 2, in which the plasma chamber comprises an enclosed spirally wound tube (75) around the cyclone chamber (2) from adjacent the product inlet hopper (12) to adjacent the fan (3) and then returned remote from the cyclone chamber (2).

7. Apparatus (1) as claimed in any of claims 2 to 6, in which the plasma chamber is filled with an inert gas carrying a metallic salt.

8. Apparatus (1) as claimed in any preceding claim, in which the vortex flow forming means comprises a vortex flow forming device (17) substantially centrally mounted within the vortex flow forming section (6), the vortex flow forming device (17) further comprising an anode and the portion of the cyclone chamber (2) forming the vortex flow forming section comprising a cathode and a DC power source connected between the anode and the cathode.

9. Apparatus (1) as claimed in any of claims 1 to 7, in which the vortex flow forming means comprises a vortex flow forming device (17) substantially centrally mounted within the vortex flow forming section (6), the vortex flow forming device (17) further comprising a cathode and the portion of the cyclone chamber (2) forming the vortex flow forming section comprising an anode and a DC power source (60) connected between the anode and the cathode.

10. Apparatus (1) as claimed in claim 8 or 9, in which the power source (60) includes a controller (61) to reverse the polarity whereby the anode becomes the cathode and the cathode, the anode.

11. Apparatus (1) as claimed in claim 10, in which each vortex flow forming device (17) comprises a magnet.

12. Apparatus (1) as claimed in claim 11, in which the vortex flow forming device (17) is one of:

an ellipsoid body in the shape of an egg (18);

an ovaloid shaped body (25);

a body of reducing cross section from its upstream end to its downstream; and

any of the above with additional flow forming vanes (27) on its exterior;

in which the magnet comprises part of the vortex flow forming device (17) with its poles axially aligned with the cyclone chamber (2).

13. Apparatus (1) as claimed in any preceding claim in which the vortex flow forming device (17) comprises an electrical generator assembly (103).

14. Apparatus (1) as claimed in claim 13, in which the downstream portion of the vortex flow forming device (17) comprises a wind turbine (104) connected to an electrical generator (105) housed within the vortex flow forming device.

15. Apparatus (1) as claimed in claim 14, in which the wind turbine comprises blades (121) mounted downstream of the vortex flow forming device (17).

16. Apparatus (1) as claimed in any of claims 13 to 15 in which the vortex flow forming device is mounted by radially arranged hollow struts (102) forming electrical cable receiving conduits for electrical power take-off.

17. Apparatus (1) as claimed in claim 15 or 16, in which the vortex flow forming device (17) is one of:

an ellipsoid body in the shape of an egg (18);

an ovaloid shaped body (25);

a body of reducing cross section from its upstream end to its downstream;

any of the above with additional flow forming vanes (27) on its exterior; and

in which portion of the downstream end of the body (106) is rotatable with respect to the rest of the body and mounts blades (107) for rotation thereof.

18. Apparatus (1) as claimed in any preceding claim, in which a plurality of magnets (73) forming a ring magnet (70, 71, 72) is mounted in the vortex flow forming section (6) in or adjacent the cyclone chamber (2) which is of a non-ferromagnetic material, one of the poles of each magnet being directed towards the vortex flow forming device (17).

19. Apparatus (1) as claimed in claim 18, in which the poles of the magnets (73) of the ring material (70) are of opposite polarity to that of the adjacent vortex flow forming device (17).

20. Apparatus (1) as claimed in claim 18, in which the polarities of adjacent poles directed into the cyclone chamber (2) forming the one ring magnet (70, 71, 72) are opposite.

21. Apparatus (1) as claimed in any of claims 18 to 20, in which there is a plurality of ring magnets (70, 71, 72) in the vortex flow forming section (6).

22. Apparatus (1) as claimed in any of claims 18 to 21 comprising a pair of vortex flow forming devices (17) mounted in the one vortex flow forming section (6) with a ring magnetic (70, 71, 72) mounted between them, the facing portions of the magnets in the vortex flow forming devices (17) being of different polarity.

23. Apparatus (1) as claimed in any of claims 19 to 21 comprising a pair of

vortex flow forming devices (17) mounted in the one vortex flow forming section (6) with a ring magnet (70, 71, 72) mounted between them, the facing portions of the magnets in the vortex flow forming devices (17) being of the same polarity.

24. Apparatus (1) as claimed in any preceding claim, in which the ionisation means comprises a source of ozone (90) for introduction into the fluid as it flows through the cyclone chamber (2).

25. Apparatus (1) as claimed in any preceding claim, in which the vortex flow shedding section (7) comprises at least two expansion chambers (80, 82) of greater cross-sectional area than that of the vortex flow forming section (6) upstream of it, the proximal chamber (80) to the vortex flow forming section (6) being of greater cross-sectional area than the distal chamber (82).

26. Apparatus (1) as claimed in claim 25, in which there are additional expansion chambers (81) of progressively reducing cross-sectional area from the proximal chamber (80) to the distal chamber (81).

27. Apparatus (1) as claimed in claim 25 or 26, in which the internal diameter of successive expansion chambers from proximal chamber (80) to distal chamber (82) are chosen so as to form a harmonic progression.

28. Apparatus (1) as claimed in any of claims 25 to 27, in which there are three expansion chambers (80, 81, 82) and the internal diameter of the intermediate expansion chamber (81) is double that of the distal expansion chamber (82) and the internal diameter of the proximal expansion chamber (80) is the sum of the internal diameters of the other two expansion chambers (81, 82).

29. Apparatus (1) as claimed in any of claims 25 to 28, in which the expansion chambers comprise shockwave generators (86).

30. Apparatus as claimed in any of claims 25 to 29, in which the outer portion of

each expansion chamber (80, 81, 82) is connected to a bleed-off vent pipe (83) which in turn feeds the cyclone chamber (2) downstream of the expansion chambers (80, 81, 82).

31. Apparatus (1) as claimed in any preceding claim, in which gas draw-off pipes (65) are provided for the removal of gases given off by the fluid as it progresses through the cyclone chamber (2) and the fan housing (4).

32. Apparatus (1) as claimed in any preceding claim, in which a coil (90) is mounted in the cyclone chamber for the collection of electricity induced by electrical charged metals entrained in the fluid causing a magnetohydrodynamic effect (MHD).

33. Apparatus (1) as claimed in any preceding claim, in which portion of the cyclone chamber (2) is adapted to form a plasma chamber.

34. A method of using the apparatus as claimed in any preceding claim comprising drawing hydrogen gas off from the fluid as it progresses through the cyclone chamber and housing.

35. A method as claimed in claim 34, comprising arranging magnets having their negative poles directed into the interior of the fan housing for extraction of the hydrogen.

36. A method of using the apparatus to treat highly acidic waste comprising using the apparatus as claimed in claim 8 and any claim dependent thereto, to first treat water to cause the water to form a negatively charged alkaline solution and dosing the acid waste with the treated water as the acidic waste is delivered through the apparatus.

37. A method of using the apparatus as claimed in any of claims 2 to 7 and those claims dependent thereon, comprising generating hydrodynamic shockwaves in the plasma chamber.